

Factors Associated with the Female Athlete Triad in Elite Para Athletes



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The Female Athlete Triad

- Defined as the interaction of three interrelated conditions:
 - Energy Availability (EA)
 - Menstrual Status (if female)
 - Bone Mineral Density (BMD)(Nattiv 2007)
- Analogous consequences noted in male athletes (Tenforde 2016)

Able-bodied athletes

- 63% of elite endurance athletes with low EA (Melin 2015)
- 29% elite collegiate athletes in a moderate-to-high risk category (Tenforde 2017)



Background

- Participation in elite para sport is rapidly growing: 4,350 athletes competed across 22 sports at the 2016 Rio Paralympic Games
- Prevalence or implications of Triad conditions is largely unknown in a para athlete population (Blauwet 2017)
- Few prior studies indicate that low EA and low BMD may be prevalent and largely dependent on disability type and sport type (Miyahara 2008, Gotkepe 2004, Krempein 2011,2012)



Purpose: Determine the presence of factors associated with low EA, menstrual dysfunction (if female), and impaired bone health in an elite para athlete population

Methods

- Survey-based study
- United States elite para athletes training to qualify for the 2016 summer or the 2018 winter Paralympic games
- Data collection in the summer of 2016 prior to the Rio Paralympic games
- 659 athletes were administered an electronic survey



Methods – Survey Elements

Demographic Characteristics

- Age, sex, race
- Disability type
- Sport type
- Ambulatory status

Energy intake behavior

- Eating Disorder Examination Questionnaire (EDEQ) (Barrack 2008)
- History of diagnosed eating disorder
- Body Mass Index (BMI)
- Attitudes towards body habitus

Menstrual status (If female)

- Oligomenorrhea, Amenorrhea
- Age of menarche

Bone health

- History of stress fracture or reaction
- History of diagnosed low BMD
- Family history

Awareness of the Triad

Athlete Characteristics

- 260 athletes (150 male, 110 female)
- Average age 31.69 (SD 11.47)
- 26 sport types represented

Disability Type	Overall (n = 260)
Spinal Cord Injury	79 (30.4)
Lower Extremity Amputee	67 (25.8)
Acquired Central Neurologic Injury	25 (9.6)
Visual Impairment	24 (9.2)
Cerebral Palsy	23 (8.8)
Upper extremity amputee	10 (3.8)
Musculoskeletal disorder of the lower extremity	9 (3.5)
Arthrogryposis	5 (1.9)
Short Stature	5 (1.9)
Other	12 (4.6)

Results - Energy Intake

Energy Intake Behavior	Overall (n = 260)	Males (n=150)	Females (n=110)
BMI (≤ 17.5)	11 (4.3)	4 (2.7)	7 (6.4)
BMI (17.6-18.4)	8 (3.1)	5 (3.3)	3 (2.7)
History of Diagnosed Eating Disorder	8 (3.1)	1 (0.7)	7 (6.4)
Elevated EDE-Q Dietary Restraint (≥ 3)	48 (18.5)	21 (14.0)	27 (24.5)
Elevated EDE-Q Pathologic Behavior (>1)	84 (32.4)	55 (36.7)	29 (26.4)
Feels pressure to maintain certain body weight	115 (44.2)	65 (43.3)	50 (45.5)
Currently changing body composition/weight for sport performance	160 (61.5)	95 (63.3)	65 (59.1)
Considers self overweight (slight, moderately, or very)	121 (46.7)	64 (42.7)	57 (51.8)

Results - Menstrual Status

Menstrual Status (Females only)**	(n = 105)
Age of menarche 15 - <16	9 (8.6)
Age of menarche >=16	5 (4.7)
	(n = 25)
Oligomenorrhea (6-9 menstrual cycles in past 12 months)	6 (24.0)
Amenorrhea (< 6 menstrual cycles in past 12 months)	5 (20.0)

** All females who provided a response were included in the age of menarche analysis (n = 105). For self-reported number menstrual cycles in the past 12 months, females under the age of 50 and those who had not taken any oral contraceptive pills within the past 12 months were included in the analysis (n = 25).

Results - Bone Health

Bone Health	Overall (n = 260)	Males (n=150)	Females (n=110)
History of 1 stress fracture/reaction	13 (5.0)	5(3.3)	8(7.3)
History of 2 stress fracture/reaction	11(4.2)	6(4.0)	5(4.5)
Low BMD diagnosis by DXA scan	22 (8.5)	8 (5.3)	14 (12.7)
Family history of osteoporosis/osteopenia	34 (13.1)	12 (8)	22 (20.0)

Key Findings

- Negative attitudes towards body habitus in over 50% of both male and female athletes of certain sport types
 - Cycling, Soccer 7-a-side, rowing, track and field
- Negative attitudes towards body habitus were found in over 50% of certain disability types
 - SCI (Females)
 - Acquired central neurologic injury (Males and Females)
 - Visual impairment (Males and Females)

Key Findings

- 42% of stress fracture or reactions reported were noted in track and field athletes
- Athletes with SCI accounted for 20.8% of stress fracture/reaction injuries and 54.5% of those with a history of diagnosed low BMD
- 8.1% of athletes were familiar with the Female Athlete Triad

Discussion

- First study to assess the presence of factors associated with the Triad across all sport and disability types in elite para athletes
- Factors associated with the Triad are present in an elite para athlete population, **regardless of sex**
- Few athletes reported a history of eating disorder, substantial number had elevated EDE-Q subscale scores, particularly track and field athletes
- Many athletes reported negative perceptions towards their weight and were actively trying to change body composition or weight to improve athletic performance.

Discussion

- Athletes with SCI had factors associated with low BMD
 - SCI athletes with reduced WB status should undergo DXA screening and monitored due to high risk
- Further research regarding the impact of such factors on short- and long- term athlete health are warranted
- Awareness and knowledge of the negative consequences of low EA should be improved within this growing athletic population

Thank you!



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References

1. Nattiv A, Loucks AB, Manore MM, et al. American College of Sports Medicine position stand. The female athlete triad. *Med Sci Sports Exerc.* 2007;39(10):1867-1882.
2. De Souza MJ, Nattiv A, Joy E, et al. 2014 Female Athlete Triad Coalition Consensus Statement on Treatment and Return to Play of the Female Athlete Triad: 1st International Conference held in San Francisco, California, May 2012 and 2nd International Conference held in Indianapolis, Indiana, May 2013. *Br J Sports Med.* 2014;48(4):289.
3. Tenforde AS, Barrack MT, Nattiv A, et al. Parallels with the Female Athlete Triad in Male Athletes. *Sports Med.* 2016;46(2):171-182. *Am J Sports Med.* 2017;45(2):302-310
4. Tenforde AS, Carlson JL, Chang A, et al. Association of the Female Athlete Triad Risk Assessment Stratification to the Development of Bone Stress Injuries in Collegiate Athletes.
5. Melin A, Tornberg AB, Skouby S, et al. Energy availability and the female athlete triad in elite endurance athletes. *Scand J Med Sci Sports.* 2015;25(5):610-622.
6. About Rio 2016. 2016; <https://www.paralympic.org/rio-2016/about-us>.
7. Blauwet CA, Brook EM, Tenforde AS, et al. Low Energy Availability, Menstrual Dysfunction, and Low Bone Mineral Density in Individuals with a Disability: Implications for the Para Athlete Population. *Sports Med.* 2017.
8. Krempien JL, Barr SI. Eating attitudes and behaviours in elite Canadian athletes with a spinal cord injury. *Eat Behav.* 2012;13(1):36-41.
9. Krempien JL, Barr SI. Risk of nutrient inadequacies in elite Canadian athletes with spinal cord injury. *Int J Sport Nutr Exerc Metab.* 2011;21(5):417-425.
10. Miyahara K, Wang DH, Mori K, et al. Effect of sports activity on bone mineral density in wheelchair athletes. *J Bone Miner Metab.* 2008;26(1):101-106.
11. Goktepe AS, Yilmaz B, Alaca R, et al. Bone density loss after spinal cord injury: elite paraplegic basketball players vs. paraplegic sedentary persons. *Am J Phys Med Rehabil.* 2004;83(4):279-283.
12. Barrack MT, Rauh MJ, Barkai HS, Nichols JF. Deitary restraint and low bone mass in female adolescent endurance runners. *Am J Clin Nutr.* 2008;87(1):36-43.